

E. Evaluation of Wastewater Treatment Technologies for Mercury Removal

By March 1, 2015, BP will complete a study and submit a report on technologies using ultra filtration and filtration with and without chemical additives (precipitants) for removing mercury from wastewater discharged from the Whiting Refinery. The study will evaluate the reliability, effectiveness, technical feasibility and estimated costs of each of the technologies evaluated, and also evaluate the estimated construction and operation timing requirements for each of the technologies evaluated. ~~The study and pilot testing shall be consistent with the recommendations of the pilot testing report issued in March 2012 by Argonne National Laboratory and Purdue-Calumet Water Institute (Argonne) and BP's letter to IDEM dated August 16, 2012 except as described below, and shall include at minimum the following:~~ To continue the technology development work that was started under the Purdue-Argonne study, BP shall conduct further study and pilot testing that will include the following activities:

1. An evaluation at the Whiting Refinery of ultra filtration technology (using GE ZeeWeed® Technology 0.04 µm pore size and made up of PVDF or an equivalent) for removing mercury from the Whiting Refinery's wastewater, utilizing protocols and methods similar to those employed by Purdue/Argonne. BP will conduct a one year long pilot-scale evaluation beginning in August 2013 to accomplish the following:
 - Determine optimum flux rate, percent recovery, and backwash frequency.
 - Quantify the effect of precipitant addition before ultra filtration on mercury removal
 - Determine the reliability and effectiveness of ultra filtration for removing mercury from the wastewater.

BP will sample influent and permeate three times per week for mercury (total and dissolved). Dissolved mercury sampling of the permeate will be conducted for the first 10 weeks only.

2. An evaluation at the Whiting Refinery of filtration technology (using the existing final filters, with and without chemical additives [precipitants]) for removing mercury from the Whiting Refinery's wastewater, ~~utilizing protocols and methods similar to those employed by Purdue/Argonne.~~ BP already has conducted 3 seasonal periods of sampling, and will conduct a fourth period of sampling for the final filters without chemical additives (precipitants) ~~in 4 seasonal periods (Fall 2012 to by Summer 2014).~~ For ~~each~~ the fourth sampling period, BP will conduct six sampling events for mercury (total and dissolved) to accomplish the following:
 - Quantify mercury removal.
 - Conduct filter media sampling to assess and quantify mercury accumulation within the filters.
 - Determine the reliability and effectiveness of filtration without chemical additives (precipitants) for removing mercury from the wastewater.

BP will conduct sampling for the final filters with chemical additives (precipitants) in 2014. BP will conduct six sampling events for mercury (total and dissolved) for each of two precipitants to accomplish the following:

- Quantify the effect of precipitant addition before the final filters on mercury removal.

Comment [A1]: It is in everyone's interest for the permit language to be absolutely clear about the technology development activities that BP will conduct. Over the past month, we have modified the draft language to include specific requirements for the sampling, testing and reporting activities. Incorporating the Purdue-Argonne report and the BP letter by reference does not add clarity to the work that BP will perform. Rather, the references to the Purdue-Argonne report create a risk of confusion if there are inconsistencies within the report or with the agreed activity set. We want the list of actions that BP has agreed to complete to be unambiguous. Because we have listed the specific actions in the paragraphs below, it is not necessary to refer to the recommendations in the Purdue-Argonne report or the proposals in the BP letter dated August 16, 2012.

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- Conduct filter media sampling to assess and quantify mercury accumulation within the filters.
 - Determine the reliability and effectiveness of filtration with chemical additives (precipitants) for removing mercury from wastewater.
3. An evaluation of the options for handling/treating of the ultra filtration reject and final filter backwash streams associated with the treatment options evaluated in accordance with E.1 and E.2. BP initially will conduct bench scale assessments of the following handling/treatment methods for the ultra filtration reject:
- Dissolved air flotation
 - Activated sludge
 - Ultra filtration
 - Evaporation
- BP will conduct bench scale assessments of ~~two of~~ the above options for the final filter backwash ~~to confirm that the final filter backwash behaves in a similar manner as, unless it is determined from~~ the ultra filtration reject ~~testing that an option is not technically feasible~~. BP also will consider the Argonne ferric co-precipitation results, scaling issues, and current full-scale operations in evaluating options for treating/handling the ultra filtration reject and final filter backwash.
4. BP will conduct composite sampling for comparison with grab samples to assess the variability of mercury in the wastewater. BP will collect at least three composite samples for mercury (total and dissolved) to compare with grab samples collected in the same period of time.
5. The evaluations, which will be performed under varying weather and process conditions, will be used to assess the reliability, effectiveness, technical feasibility, and environmental impacts of each of the treatment technologies for reducing mercury in the discharge. BP will determine the mercury removal capability of each technology configuration evaluated (the mercury concentration and loading that was achieved in the effluent under the various operating conditions). BP will identify the optimal configuration for mercury removal capability for each technology, including the handling/treatment method for ultra filtration reject or final filter backwash.
6. For each of the treatment technologies evaluated, BP will estimate the timing requirements that would be needed for full-scale implementation and operation, including estimated timing for engineering, procurement, construction and commissioning. BP will evaluate the comparative complexity of implementation as identified by differences in implementation timeframes among the technologies evaluated.
7. For each of the treatment technologies evaluated, BP will develop estimates of the costs for full-scale installation and operation of the technology at the Whiting Refinery. The estimates will include estimates of the costs for installing the technology, annual costs for operating and maintaining the technology; and annual costs associated with handling ultra filtration reject or final filter backwash streams. BP will use the cost information in conjunction with the

information developed in performing the evaluations described in E.1 – E.5 to evaluate the cost-effectiveness of the treatment technologies evaluated.

8. The report, which BP will submit to IDEM following completion of the study but in no event later than March 1, 2015, shall include an executive summary; a detailed summary of the information that BP generated in performing the evaluations and schedule development described above; all of the monitoring data that BP obtained in the course of the study and pilot testing; and conclusions for each technology evaluated as to (1) whether the technology is capable of reducing mercury from wastewater at the Whiting Refinery and if so, the mercury concentration levels that could be consistently achieved in discharges from the Whiting Refinery following full scale construction and implementation of the technology; (2) the costs of each technology evaluated; and (3) any significant environmental or other reasons why one or more technologies might be preferable to others.

F. Evaluation of Mercury Removal Efficiency of the Brine Treatment Unit

BP will conduct an evaluation of the mercury removal performance of the Brine Treatment Unit. BP will conduct monthly sampling for one year after the Brine Treatment Unit becomes fully operational. BP will sample the influent and effluent at the Brine Treatment Unit for mercury (total and dissolved) to accomplish the following:

- Determine the reliability and effectiveness of the Brine Treatment Unit for removing total and dissolved mercury from the wastewater.

BP will submit the results of this evaluation within six months after the sampling program is completed.

G. Evaluation of Filter Sizes on Mercury Removal

BP will filter clarifier and final filter effluent through different-sized filter paper to determine the resulting TSS and total mercury levels. The results of this testing will be considered along with other factors, such as TSS removal and operability, that BP uses to evaluate selection of filter media.